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STUDIES IN NORTH AMERICAN PERONO- SPORALES—VI. NOTES ON MISCEL- LANEOUS SPECIES

GUY WEST WILSON

(WITH PLATES 135 AND 136, CONTAINING 22 FIGURES)

KAWAKAMIA Miyabe; Miyabe & Kawak. Bot. Mag.
Tokyo 17: (306). 1903

This genus was established for the *Cyperus*-inhabiting species, *Peronospora Cyperi*. This fungus which is a native of Japan has been collected once at Pierce, Texas, on imported plants of its host, *Cyperus tegetiformis* Roxb. According to its author the genus is closely related to *Phytophthora*. Through the courtesy of Mrs. Flora W. Patterson the writer was enabled to make a careful study of both American and Japanese material of the species in the herbarium of the Bureau of Plant Industry. While the measurements of the American specimens are slightly larger than those of the Japanese, there is no question as to their identity. The conidia present a striking likeness in outline to those of *Phytophthora*, but the pedicel is more conspicuous than in any species of this last genus.

The genus *Kawakamia* appears to the present writer to agree more closely with *Basidiophora*. In *Basidiophora* the conidiophore is much enlarged at the apex, and bears a number of cylindric branches on each of which a large, oval, papillate is produced. This conidium breaks away with a portion of the so-called basidial branch adhering as a pedicel-cell much as in the case of the teliospores of the Uredinales. In *Kawakamia* the conidiophore is somewhat different, but strikingly similar. The conidiophore is simple and bears a single conidium on a portion of the conidiophore which is differentiated from the remainder of the hypha both in size and structure. In appearance and structure the fertile portions of the conidiophores both of *Basidiophora* and of *Kawakamia* are similar. In each genus the conidia fall away with the pedicel-cell attached. As these characters are so similar in the

two genera we may characterize *Kawakamia* as *Basidiophora* without the apical clavate enlargement of the conidiophore which bears one instead of several conidia.

PERONOSPORA BORRERIAE Lagerh.; Pat. & Lagerh. Bull.
Soc. Myc. France 8: 123. 1892

Like many of the other species of fungi which Professor Lagerheim collected in Ecuador the present one appears not to have been reported from additional localities. Nor is this the only point of interest in connection with this species, as it is neither a *Peronospora* in the strict sense of the word, nor does its host belong to the genus *Borreria*. Although the original description calls for dichotomously branched conidiophores the specimen in the Ellis collection at the New York Botanical Garden shows only monopodially 4-5-times branched conidiophores with the pronouncedly conic and narrowly pointed ultimate branchlets which are so characteristic of that section of the genus *Rhysotheca* which contains the species *R. Viburni*, *R. ribicola*, and *R. Gonolobi*. Indeed it approaches the last named species quite closely in both size and habit. The conidia are also nearest to those of that species, but their ovoid outline readily distinguishes them from those of any of the other species just mentioned. The present species should stand next to *R. Gonolobi*. An examination of the host shows it to be *Mitrocarpus hirsutus* (L.) DC., a species common throughout tropical America. We may, therefore, look for future collections of this fungus from other localities. The species should be known as **Rhysotheca Borreriae** (Lagerh.) G. W. Wilson.

RHYSOTHECA HELIOCARPA (Lagerh.) G. W. Wilson
Bull. Torrey Club 34: 402. 1907

This species was described by Lagerheim from Ecuador on *Heliocarpus*. So far as the present writer has been able to learn it has not been reported in any subsequent paper. It was with considerable pleasure and surprise that a packet of material from Cuba from the collections in 1903 by the late Professor L. M. Underwood and Professor Earle was examined and found to be this species. The material was collected at the base of El Yunque

Mt., Baracoa, during the month of March. The host is a species of *Triumfetta*, apparently *T. Lappula* L., a species which was also collected in the same region. The Cuban material is slightly more slender than the Ecuadorian, but is otherwise the same.

Pseudoperonospora Humuli (Miyabe & Takah.) nom. nov.

Peronoplasmopara Humuli Miyabe & Takah. Trans. Sapporo Nat. Hist. Soc. 1: 153. 1907.

Pseudoperonospora Celtidis Humuli Davis, Science II. 31: 753; (hyponym). 1910.

Plasmopara Humuli Miyabe & Takah. in Sacc. & Trott.; Sacc. Syll. Fung. 21: 861. 1912.

This species first attracted attention by a serious outbreak in the hop-fields in the Province of Sapporo, Island of Hakkaido, Japan. It was later collected on the wild hops of the same island as well as on those of the Island of Honshu. Some years later Doctor Davis collected a fungus on the wild hops of Wisconsin which he considered quite close to *P. Celtidis*, but entitled to subspecific rank. Through the kindness of Mrs. Flora W. Patterson the writer has been able to examine Japanese material of this species and to compare it with specimens submitted by Doctor Davis. As in the case of *Kawakamia Cyperi* the measurements of the American material do not agree exactly with those of the Japanese specimens, but otherwise the similarity is too great to admit a question of their identity.

PERONOSPORA ERODII Fuckel. Fungi. Rhen. 2102. 1867—
Symb. Myc. 68. 1869

This species was issued by D. Saccardo in his *Mycotheca Italica* 890 as *Plasmopara Erodii* (Fuckel) D. Sacc. A note on the label states that in as much as the form on *Erodium* produces conidia which germinate by zoospores it cannot be considered identical with *Peronospora conglomerata* Fuckel, on *Geranium*, to which European mycologists usually refer it. The correctness of this observation is further supported by the form of the conidia and the type of the conidiophores which indicate that the species is a member of the genus *Pseudoperonospora* and should be known as ***Pseudoperonospora Erodii*** (Fuckel) G. W. Wilson.

Bremiella gen. nov.¹

Conidiophores from the stomata, the branches few and quite long, the main axis breaking up dichitomously or pseudo-monopodially, the ultimate branchelets quite long and terminating in an apophysate enlargement; conidia papillate, basally constricted and somewhat pyriform, hyaline, germinating by zoospores: oospores conspicuously wrinkled, free in the oogonium.

Type, *Peronospora megasperma* A. Berlese.

The downy-mildew of the violets of Europe and of America are two very distinct fungi which should never have been confused. *Peronospora Viola* De Bary is a typical member of the genus. The American form, which was first recognized as a distinct species in 1899 and named *Peronospora megasperma*, is such an anomalous form that the same author later transferred it to the genus *Plasmopara*.

Apparently the first collection of the American species was made in April 1882 by Professor F. S. Earle, who supplied material to Ellis for his North American Fungi. Of this material Doctor Farlow writes "The specimens received from Mr. Earle were collected in April 1883 (sic), and can be referred without doubt to this form their resemblance to *P. effusa* var. *minor*"² A note in a packet of this same collection in the Earle herbarium at the New York Botanical Garden calls attention to the swollen ends of the conidiophores and credits Professor Burrill with having pointed out the essential differences which we have noted between this and the European species. Upon the same authority the conidia are also said to germinate by means of zoospores. The conflicting evidence leaves it an open question whether or not both of the violet-inhabiting species occur in America. It appears, however, from an examination of the material at hand that in all probability we have in America only one species. This we have designated **Bremiella megasperma** (A. Berlese) G. W. Wilson.

¹ Hyphis conidiophoris solitaris vel fasciculatis, e stomatibus plantarum erumpentibus, dichotomo-vel pseudo-monopodio-ramosis; ramuli terminalis longis, apice in vesiculam apophysatam abientibus; conidis hyalinis, pyriformibus, apice papillatis, per zoosporas evacuantia; oosporis subrugosus.

² Bot. Gaz. 8: 328. 1883.

PERONOSPORA DESTRUCTOR (Berk.) Casp.; Berk. Outl. Brit. Fung. 349. 1860

Botrytis destructor Berk. Ann. Mag. Nat. Hist. II. 6: 436. 1841.

Peronospora Schleideni Unger, Bot. Zeit. 5: 315. 1847.

Peronospora Schleideniana Unger: De Bary, Ann. Sci. Nat. IV. 20: 122. 1863.

The synonymy of this species has been discussed briefly by Professor Whetzel,³ but as this author retains the last name in preference to the first it may not be out of place to again call attention to the nomenclatural vicissitudes of the species. First described by Berkeley as *Botrytis destructor* the same author later lists it under *Peronospora*, citing the earlier synonym, and crediting the combination to Caspary, probably in recognition of some manuscript name. Meantime Schleiden found the same species in Germany and figured it with a brief description, calling it *Botrytis (parasitica?)*.⁴ This forms the basis of *Peronospora Schleideni* Unger, which was later amended to *P. Schleideniani* in De Bary's revision of the group. While the weight of this authority has given the latter name wide usage, the older one is the proper designation of the species.

PERONOSPORA ARENARIAE MACROSPORA Farl. Bot. Gaz. 9: 38. 1884. Not *Peronospora macrospora* Unger. 1847

Of the six species of *Peronospora* which infest members of the pink family three have tuberculate oöspores. Two of these species are European, *P. Dianthia* De Bary being found on species of *Dianthus*, *Agrostemma*, and *Lychnis* and *P. Arenariae* De Bary on *Arenaria* and related genera, while the third is an American species on *Silene*. In 1884 Professor Farlow first called attention to the American species, pointing out its intermediate position between the two European species just mentioned and giving it a varietal position under the later of these. An examination of American material and a comparison with both of the foreign species has convinced the writer that the form under consideration is entitled to specific rank. While the oöspores are larger than those of *P. Arenariae* they are otherwise quite similar. The

³ Bull. Cornell Agr. Exp. Sta. 218: 149. 1904.

⁴ Grundz. Wiss. Bot., ed. 3, 2: 37, f. 106. 1849.

conidiophores are also more like those of *P. Arenariae*, but suggesting somewhat *P. Dianthi*. This last species, however, is somewhat stouter than the others. The conidiophore of the American species is somewhat more branched than *P. Arenariae* and has much more slender ultimate branchlets than does the European species. As the varietal name is untenable for a species in the genus this fungus may be renamed **Peronospora Silenes** G. W. Wilson.

PERONOSPORA PARASITICA (Pers.) FRIES AND ITS
SEGREGATES

While it has been customary to consider any collection of *Peronospora* on a Cruciferous host as certainly belonging to *P. parasitica* a very wide range of variation has been allowed in the characterization of the species. True, various names have been applied, especially by the earlier authors, to the fungus as it appears on various hosts. The majority of these names, however, represent what may be termed "host species," *i. e.*, their chief distinguishing characteristic is their host.

The first valid segregation by an European mycologist was based on an error in the determination of the host. The case in point is *P. Niessleana* A. Berlese, based on a specimen in the herbarium of Niessl which was labeled *P. Phyteumis* Fuckel, on *Phyteuma*, but evidently not that species. So thoroughly convinced does this author appear to have been that the fungus in question was distinct from other recognized species that when it was found that the host was in reality *Alliaria* he retained the form as a subspecies under *P. parasitica*. What appears to be the same species of fungus was figured by Sowerby as *Mucor Erysimi*. Berlese's first judgment was better than his last, as the form is certainly entitled to specific rank.

A careful study of a wide range of specimens has convinced the writer that there is still a third form on the Cruciferae which deserves to be accorded specific rank. The more comprehensive of the published descriptions have recognized a form of *P. parasitica* with comparatively simple conidiophores which have a more open head. This form is quite widespread in America, and from the literature it appears to be common in Europe. A subspecies

has been described from Australia by McAlpine as *P. parasitica Lepidii*, which is based upon essentially the same set of characters. Through the courtesy of Professor McAlpine the writer has been enabled to examine cotype material of the Australian fungus which proves to be in every way identical with the American form.

The synonymy of these species and a description of the third one follows. No account is taken here of *P. crispula* Fuckel, on *Reseda* in Europe, which has frequently been referred as a synonym to *P. parasitica*, but which is certainly to be regarded as a valid species.

1. PERONOSPORA PARASITICA (Pers.) Fries, Sum. Veg. Scand.

493. 1849

Botrytis parasitica Pers. Obs. Myc. 1: 96. 1796.

Mucor Botrytis Sow. Eng. Fungi pl. 359. 1802.

Botrytis nivea Mart. Fl. Crypt. Erlang. 342. 1817.

Peronospora ochroleuca Ces. in Rab. Herb. Viv. Myc. II. 175. 1855.

Peronospora Dentariae Rab. Fungi Europ. 86—Flora 42: 436. 1859.

Peronospora Botrytis Cocconi & Morini, Mem. Acad. Sci. Ist. Bologna IV. 6: 394. 1885.

2. PERONOSPORA NIESSLEANA A. Berlese, Icon. Fung. Phyc. 40. pl. 66, f. 1. 1898

?*Mucor Erysimi* Sow. Eng. Fungi pl. 400, f. 7. 1803.

Peronospora parasitica Niessleana A. Berlese, Icon. Fungi Phyc. 41. 1898.

3. *Peronospora Lepidii* (McAlp.) sp. nov.

Peronospora parasitica Lepidii McAlp. Proc. Royal Soc. Victoria 7: 221. 1895.

Hypophylloous or caulicolous, covering the irregular and more or less indefinite infected area with a dense white growth; conidiophores 3-8 from a stoma, 130-223×4-9 μ , 3-8 times branched, the primary branches erect, the ultimate branchlets straight or somewhat recurved, arising at acute angles, about 3×8 μ ; conidia broadly ellipsoid or almost globose, 15-23×18-35 μ , hyaline; oögo-

nia with a thick, yellowish membrane which does not collapse; oöspores subglobose, 25–50 μ , episporous yellowish-brown, wrinkled.⁵

ON BRASSICACEAE:

Arabis virginica (L.) Trel., Alabama, *Underwood*.

Bursa Bursa-pastoris (L.) Britton, Kentucky, *Kellerman*.

Coronopus didyma (L.) J. E. Smith, North Carolina, *Wilson*.

Lepidium apetalum Willd., Iowa, *Wilson*; Nebraska, *Sheldon*.

Lepidium Virginicum L., Illinois, *Seymour* (Econ. Fungi 258a); Kansas *Bartholomew* (Fungi Columb. 2129); Kentucky, *Kellerman* (Fungi Europ. 2870, N. Am. Fungi 1460b); New Jersey, *Halsted* (Econ. Fungi 258b); North Carolina, *Stevens*.

Lepidium sp., Idaho, A. A. & E. G. Heller, 3020.

Roripa palustris (DC.) Bessey, Iowa, *Hitchcock*.

Roripa sp., Alabama, *Underwood*.

Sophia sp., Colorado, *Bethel*.

DISTRIBUTION: New Jersey to Alabama and Colorado. Also in Australia, and probably in Europe.

TYPE LOCALITY: Ardmona, Victoria, Australia, on *Lepidium ruderale* L.

The three species on Cruciferous hosts may be briefly characterized as follows: *P. parasitica*, with much branched conidiophores, the branches forming a dense tangled head, *P. Niessleana* having an open headed conidiophore which branches 2–4 times, the branches widely spreading and with the extremities rather recurved, *P. Lepidii* with the main branches of the conidiophore ascending, but not forming a dense head as in *P. parasitica*.

PERONOSPORA SCHACHTII Fuckel, Fungi Rhen. 1508—

Symb. Myc. 71. 1869

This species, which is readily distinguished from the others which inhabit Chenopodiaceous hosts by the straight branches of

⁵ Hypophyllis vel caulicolis, caespitulis densis, albis; conidiophoris 3–8 fasciculatis, 130–223 \times 4–9 μ , 3–8-ies ramosis, ramis inferioribus rectis, angulato-divergentibus, penultimis et ultimis subulatis, acutangulo-divergentibus, rectis vel saepius recurvatis, subaequalibus, circa 3 \times 8 μ ; conidiis late ellipticis vel fere globosis, 15–22 \times 18–35 μ , hyalinis; ooginis e tunica crassa, pallide-lutea, persistenti formatis 35–60 μ ; oosporis subglobosis, 25–50 μ , episporis luteo-brunneis, rugosis.

its conidiophores, has recently appeared on the sugar beet in California. So far as recorded the species appears to be known only on cultivated beets, except in Portugal where Professor Lagerheim found it on the wild *Beta marina*. Fortunately from the agricultural standpoint the fungus does not seem to thrive as well in our climate as have some other imported forms. It is to be hoped that it may not prove a serious pest here.

PERONOSPORA EFFUSA (Grev.) Ces.

This name has been applied very loosely to various members of the genus *Peronospora* from hosts of several widely separated families, but in recent years the name has been restricted to the *Peronospora* on Chenopodiaceous hosts other than the genus *Beta*. Two forms of *P. effusa* are usually recognized by mycologists, but there is such wide diversity in the application of the names that the material referred to var. *minor* by one author is called var. *major* by another. While the taxonomic history of the species is not long in list of names the earlier descriptions were drawn up at a time when "brevity was indeed the soul of wit."

The description of *Botrytis effusa* Grev. is accepted as the starting point of the history of the species. This name was proposed for a parasite of *Spinacia oleracea* in Scotland. The fungus was figured a few years later by Desmaziers⁶ who represents the divaricate form on spinach. He also adds *Atriplex*, *Chenopodium*, *Urtica* and *Rhinanthus* to the list of hosts and makes a query as to whether or not *B. effusa* Grev. and *B. farinosa* Fries are identical. The latter species is evidently rather closely related to the former which is not mentioned by Fries. The type of *B. farinosa* came from leaves of *Atriplex*, but older saprophytic species are cited as synonyms.. From the descriptions of these two species of *Botrytis* we may feel sure that the first refers to the *Peronospora* on *Spinacia* and the second to that on *Atriplex*.

The species were transferred to *Peronospora* by Cesati and within a few years other names were added to the synonymy of the species. Schlechtendal had just previously described a species on *Chenopodium hybridum* which he called *Peronospora Chenopodii*. While his description is very indefinite, his material is quite

⁶ Ann. Sci. Nat. II. 8: pl. 1. f. 2. 1837.

unlike that figured by Desmazieres, having flexuose branches with the ultimate branchlets strongly recurved. That is to say, if we adopt the classification proposed by Berlese the material of Greville and Desmazières would fall in the section *intermediate* while that described by Schlechtendal belongs to *divaricatae*. That *Peronospora effusa* presented a wide range of variation was first pointed out by Caspary⁷ who recognized two varieties, α *major* being the typical intermediate form of the older authors, while β *minor* on *Atriplex patula* from Bonn is the undulate form..

Recently Laubert⁸ discussed the variations within the accepted limits of the species and figured portions of the conidiophores of the two forms. He does not refer to the synonymy of the species nor propose any new name for either form. In the course of the review of this article Detmann removes the typical portion of the species from *Peronospora effusa* and calls it *P. Spinaciae* n. sp.

The most recent pronouncement on the question comes as an echo from the Brussels congress where the assembled botanists of the world in their wisdom decreed that those fungi not otherwise provided for should begin their historical career with Fries's *Systema*. As this work contains the reference noted above to *Botrytis farinosa* and its saprophytic habits but does not mention the earlier better defined and strictly parasitic *Botrytis effusa*, Doctor Keissler concludes that it is necessary to take up *Botrytis farinosa* and drop *P. effusa* to the realm of prehistoric nomenclature. He accordingly transfers the name to *Peronospora*, cites the stock synonyms, and then issues in "Kryptogamae exsiccatae" 1829 two specimens, "a) Austria inferior: ad folia *Chenopodii albi* L. . . . b) Hungaria: ad folio *Chenopodii hybridi* L. . . ." The first of these is *P. farinosa* as treated in the present paper, while the second belongs to the other side of the species.

A careful study of these forms leads to the conclusion that as usually construed *Peronospora effusa* consists of two quite dissimilar species. The complete synonymy as well as the list of hosts from which material was studied follows.

⁷ Rab. herb. Viv. Myc. II. cent. 2. 172. 1855.

⁸ Gartenflora 55: 433-440. f. 45. 1906.

1. PERONOSPORA EFFUSA (Grev.) Ces. in Rab. Herb. Viv. Myc. I.
1880. 1854

Botrytis effusa Grev. Fl. Edin. 468. 1824.

Peronospora effusa α *major* Casp. Monatsb. K. Preuss. Akad. Wiss. 1855: 328. 1855.

Peronospora Spinaciae Detmann, Bot. Cent. 105: 25. 1907.

HOSTS: **America**, *Chenopodium album*, *C. hybridum*, *Mono-lepis Nuttalliana*, *Spinacia oleracea*. **Europe**, *Chenopodium polyspermum*, *C. hybridum*, *Spinacia oleracea*.

Most abundant on *Spinacea oleracea*.

2. PERONOSPORA FARINOSA (Fries) Keissler, Ann. K. K. Naturh. Hofm. Wein 25: 229. 1911

Botrytis farinosa Fries, Symb. Myc. 3: 404. (Excl. synonymy.) 1823.

Erineum atriplicinum Nestler; Fée, Mem. Phyll. et Erineum 59. 1834.

Peronospora Chenopodii Schlecht. Bot. Zeit. 10: 619. 1852.

Monosporium Chenopodii Schlecht. Bot. Zeit. 10: 619. 1852.

?*Peronospora Chenopodii* Casp. Bot. Zeit. 12: 565. 1854.

Peronospora effusa β *minor* Casp.; Rab. Herb. Viv. II. 172. 1855.

Peronospora epiphylla Pat. & Lagerh. Bull. Soc. Myc. France 7: 167. p. p. 1891.

HOSTS: **America**, *Chenopodium album*, *C. hybridum*, *C. leptospermum*. **Europe**, *Atriplex patulla*, *Chenopodium album*, *C. Bonus-Henricus*, *C. glaucum*, *C. hybridum*, *C. Murale*, *C. rubrum*, *Spinacia oleracea*. **Asia**, *Chenopodium album*.

Most abundant on species of *Chenopodium* and *Atriplex*.

SPECIES OF PERONOSPORA WHICH INFEST EUPHORBIACEAE

Four species of *Peronospora* have been described from hosts of the family Euphorbiaceae. The first of these was *P. Pepli* Durieu⁹ which was found in France on *Euphorbia Peplis* L. While the author does not give a formal description of his plant he speaks of the conidiophores in a way to bear out his statement

⁹ Ann. Soc. Linn. Bordeaux 20: — (13). 1855.

that the fungus is similar to *Botrytis parasitica*. It would appear that he had a species of *Peronospora*, but it is impossible to say which one without seeing material of his collection. In the course of his remarks he refers to the remarkable phenomenon of the same plants also harboring a species of *Erysiphe*, and, to judge from the comments of his contemporaries, the material which he disturbed among them contained only the later fungus.

In 1863 Fuckel issued in his *Fungi Rhen. 40* a *Peronospora* on *Euphorbia platyphylla*, naming it *P. Euphorbiae*, and in his monograph of the same year De Bary described another species from *Euphorbia Syparissias* as *P. Cyparissiae*.¹⁰ Through the kindness of Doctor Tranzschel it has been possible to examine material from Fuckel's exsiccati. A comparison of this with authentic material of *P. Cyparissiae* shows them to be distinct from each other as well as from the species to be mentioned later. *P. Euphorbiae* has hyaline conidia, while *P. Cyparissiae* has violet ones. *P. Euphorbiae* has slender conidiophores which are 6-8 times branches, the ultimate branchlets rather widely divergent, the branches straightish, and forming a rather close head. *P. Cyparissiae* has a stouter conidiophore with more erect habit, and a closer head, the ultimate branchlets also widely divergent. As the oospores of *P. Cyparissiae* are unknown no comparison on this point can be made.

The next species to be described was *P. andina* Speg.¹¹ from Argentina, which is much smaller than the preceding. The conidiophores are rather small, branching 3-5 times, the branches spreading, the ultimate branchlets rather flexuose, and forming an open head. The conidia are hyaline. The oospores are unknown.

The North American species of *Peronospora* on hosts of this family has been variously recorded as *P. Euphorbiae* and *P. Cyparissiae*. A close study of the American fungus and a comparison with these European species shows it to differ in several respects from either of them. As our species has violet conidia we can dismiss *P. Euphorbiae* with the remark that its oospores are more wrinkled than those of our species. Its conidia, while of the same color as those of *P. Cyparissiae* are slightly more

¹⁰ Ann. Sci. Nat. IV. 20: 124.

¹¹ Ann. Mus. Nac. Buenos Aires III. 12: 282. f. 3. 1909.

rounded, while the conidiophores present still more marked contrasts. In the American species the conidiophores are more branched than in either of the European species, the branches are rather flexuose and incurved, forming a denser head than in either of these species. In our species, the conidiophore branches are more slender and the ultimate branchlets longer than in the European. As this series of differences is sufficient to warrant the separation of our form as a distinct species, a diagnosis follows, under the name *Peronospora Chamaesycis*, as all its hosts belong to this segregate of *Euphorbia*.

***Peronospora Chamaesycis* sp. nov.**

Hypophyllous, forming a dense bluish felt-like growth on the host, epiphyllous discoloration not prominent, rather chloratic or somewhat yellowish; conidiophores solitary or only two or three from a stoma, $200-450 \times 6-10 \mu$, branching 6-9 times, the branches elongate, slender, more or less flaccid, and having a tendency to be incurved, more or less flexuose, the ultimate branchlets at right angles, subequal, the axial longer, somewhat subulate, slender, straight, $5-8 \times 2-4 \mu$; conidia globose to ovoid, $20-28 \times 12-20 \mu$, violet; oögonia thin walled, yellowish; oospores $30-40 \mu$, yellowish-brown, epispose smoothish or more or less wrinkled.¹²

Type, on *Chamaesyce serpens* (H.B.K.) Small, Rooks County, Kansas, E. Bartholemew, Aug. 25, 1902. Issued as *Fungi Columbiana* 1750, in the herbarium of the New York Botanical Garden.

ON EUPHORBIACEAE:

Chamaesyce glyptosperum (Engelm.) Small (*Euphorbia glyptosperum* Engelm.), Nebraska, Bates (*Fungi Columb.* 2338).

Chamaesyce humistrata (Engelm.) Small (*Euphorbia humistrata* Engelm.), Indiana, Wilson.

Chamaesyce maculata (L.) Small (*Euphorbia maculata* L.), Illinois, Conkling; Indiana, Arthur Wilson; Iowa, Hitchcock, Wilson; Massachusetts, Farlow (*N. Am. Fungi* 216); New Jersey, Ellis.

¹² Maculis epiphyllis decoloratis, griseo- vel diluto-aureiis; conidiophoris hypophyllis, dense caespitosis, 1-3 e stomatibus erumpentis, $200-450 \times 6-10 \mu$, 6-9-ies ramosis, ramis elongatis, gracilibus, flaccidis, incurvatus, flexuosis, ultimis subequalibus, axilibus longiore, subulatis, rectis, $5-8 \times 2-4 \mu$; conideis globosis vel ovoideis, $20-28 \times 12-20 \mu$, violaciis; oogoniis auriis; oosporis $30-40 \mu$, aureo-brunneis, epispose crassis.

Chamaesyce serpens (H.B.K.) Small (*Euphorbia serpens* H.B.K.), Kansas, *Bartholomew* (*Fungi Columb.* 1750).

Chymaesyce stictospora (Engelm.) Small (*Euphorbia stictospora* Engelm.), Nebraska, *Bates* (*Fungi Columb.* 2128).

DISTRIBUTION: Throughout the northeastern United States.

PERONOSPORA TRIFOLIORUM De Bary, Ann. Sci. Nat. IV.

20: 117. 1863

This species, which has been known in America until recent years as most abundant on certain species of *Astragalus*, has appeared on alfalfa (*Medicago sativa*) in numerous localities from New York to California. In some localities it appears to be of rather slight economic importance, while in others it is reported to cause serious trouble. To judge from the specimens available for study the form on *Medicago* is slightly more slender than that on *Trifolium*, and several times as abundant, even in Europe, on that host as on all the various species of *Trifolium* together. It would appear that the species is made up of races only slightly different from each other morphologically, but with unequal virulence.

PERONOSPORA PLANTAGINIS Underw. Bull. Torrey Club

24: 83. 1897

This is a quite different species from the older and better known *P. alta* Fuckel, which is common in the northern states on *Plantago major* and other broad-leaved perennial species of the genus. The conidiophores of *P. Plantaginis* are a trifle stouter, with a smaller head, and straighter branches, with the ultimate branchlets much smaller. The conidia are also shorter and not so blunt as in *P. alta*. This species is found on *Plantago aristata* from North Carolina to Alabama. In the region of Raleigh, North Carolina, where the writer had the opportunity of studying the fungus in the field it was very abundant, sometimes appearing to be quite injurious to its host.

The oöspores of neither *P. Plantaginis* nor *P. alta* have been described. It is consequently a matter for regret that the specimen on *Plantago pusilla* from Alabama in the Ellis collection has no conidiophores so that the species of *Peronospora* could be de-

terminated, as oöspores are present in abundance. They very evidently belong to a species of *Peronospora*, rather than to a Chytridiaceous fungus. They are yellowish-brown, quite large, measuring 60-95 μ across, and have a conspicuously wrinkled episore.

PERONOSPORA PHLOGINA Dietel & Holway, Bot. Gaz.
19: 306. 1894

Two species of *Peronospora* have been described from hosts of the family Polemoniaceae. The first of these, *P. Phlogina*, was described from material collected by Professor Holway at Decorah, Iowa, on *Phlox divaricata*. The next year *P. Giliae* Ellis & Ev.¹³ was described from northern Idaho on an undetermined species of *Gilia*. Such is the uncertainty of matters taxonomic that the host is no longer considered to belong to that genus, but to one of the recent segregates. It accordingly bears the name *Microsteris gracilis* (Dougl.) Greene. While the two species of fungi have found their way into separate sections of the genus *Peronospora* in Berlese's monograph they agree in all essential details. The conidiophores are of the same type, the conidia present less variation than do those of some species of the genus, and all together there does not appear to be more variation than can reasonably be expected in a species, especially one so poorly known. These species, therefore, must be united under the older name.

PERONOSPORA POTENTILLAE De Bary, AND ITS SEGREGATES

While various species of *Peronospora* have been described on widely separated genera of Rosaceae they have, with the exception of *P. sparsa* Berk. on species of *Rosa*, at one time or another been referred to *P. Potentillae*. Three of these species are present in America, and it is with these that we are at present concerned. *Peronospora Potentillae* De Bary, the older of these species, was originally described from material on a species of *Potentilla*. As further collections were made it was found to be prevalent on several other genera of herbaceous Rosaceae. Later two French botanists, Roze and Cornu, described *Peronospora Fragariae*.¹⁴

¹³ Cont. U. S. Nat. Herb. 3: 276. 1895.

¹⁴ Bull. Soc. Bot. France 23: 242. 1876.

from *Fragaria vesca* in France. This is a very large species, the conidiophores reaching the rather startling height of a millimeter, and branching more profusely than do those of other species on Rosaceous hosts. The conidia, as might be expected, average a little larger also. As the leaves of *Fragaria* and certain species of *Potentilla* which are infected with the fungus are not sufficiently different either in texture or hairiness to account for the wide variation between the fungi on them we are led to conclude that they represent two valid species.

The third species with which we are concerned, *P. Rubi* Rab.¹⁵ was distributed by Rabenhorst on *Rubus fruticosus* from Germany. In the *Rubus*-inhabiting fungus the conidia and conidiophores are nearer the same size as those of *P. Potentillae* than is the case with *P. Fragariae*. However, the two species, similar as they are, are quite readily distinguishable. *P. Rubi* has conidiophores more branched, with longer ultimate branchlets, and a denser head, while the conidia are somewhat broader and darker in color than those of *P. Potentillae*.

From the foregoing comparison we conclude that there are in America three species of *Peronospora* on Rosaceous hosts. These are *P. Rubi* Rab. confined to the shrubby genus *Rubus*, *P. Fragariae* Roze & Cornu, collected in Iowa on *Fragaria*, and *P. Potentillae* De Bary on various species of *Agrimonia*, *Geum*, and *Potentilla*. Besides these *P. sparsa* Berk. is found occasionally on *Rosa*.

PERONOSPORA ARTHURI Farlow, Bot. Gaz. 8: 315. 1883

This species, which appears to be rather widespread and somewhat sporadic in its appearance, presents an interesting puzzle to those who follow Schröter and Fischer in dividing the species of *Peronospora* into two groups on the basis of oöspore markings, placing in *Calotheca* all those species which have reticulate or tuberculate oöspores and in *Leiotheca* those having smooth or wrinkled oöspores. In the present species the oöspores possess pronounced characters of both these groups, as the episore is conspicuously wrinkled, and thickly covered with short blunt tubercles.

¹⁵ *Fungi Europ.* 2676 (hyponym) 1881.—Schröt. in Cohn, *Krypt. Fl. Schles.* 3¹: 250. 1886.

PERONOSPORA TRICHOMATA Massee, Jour. Linn. Soc. **24**: 48.
pl. I, f. I. 1887

The species so designated is described as causing a serious root-rot disease of *Colocasia esculenta* in Jamaica. This subterranean habit is at variance with the usual place of growth of members of this family, all of which are leaf parasites, or at least grow on the aerial parts of the host. The author's figures are not convincing that the fungus in question has been properly referred. It would appear from them that the conidial part of the species belongs to some genus of Hyphomycetes, probably *Verticillium*, and that the oösporic phase belongs elsewhere in the same group. A careful study of material from the herbarium of Professor Massee confirms this view. The species, then, is to be excluded from the genus *Peronospora* and transferred to the Hyphomycetes. As *Phytophthora Colocasiae* Rac. is now known to cause a tuber rot in India it is not improbable that this species was the real offender, while the fungi described may have been merely secondary saprophytes.

It is not impossible that the material submitted to Massee was affected by *Phytophthora Colocasiae* Racib., and that this fungus was overgrown by those which he described.

PERONOSPORA NICOTIANAE Speg.

From time to time various alarmist reports have appeared as to the dire consequences of the spread of either the present species or *Phytophthora Nicotianae* Van Breda de Haan into tobacco growing countries other than their native lands. It is accordingly cause for some little surprise that mycologists have so far failed in the majority of cases where they have come in contact with this species to recognize it as the dreaded foe for which they were looking. The history of the species was given in brief in so far as it referred to certain hosts, in a former number of this series.¹⁶ In addition to the cases mentioned in that paper two others deserve mention. Harkness and Moore have recorded *Peronospora sor-dida* on *Nicotiana Bigelovii* from Nevada. This, with the record by Professor Farlow of *P. Hyoscyami* on *N. glauca* in California, would indicate that *P. Nicotianae* was probably not a formidable

¹⁶ Bull. Torrey Club **35**: 364. 1908.

foe to the American tobacco grower. However evidence comes from a different quarter which is not so quieting. For a term of years serious outbreaks of a seed-bed disease of tobacco plants in Australia caused much loss to the tobacco growers of the colony of Victoria. Material submitted to Professor Massee for identification was pronounced *P. sordida* Berk. a very different species which is confined to certain genera of Scrophulariaceae. However this Australian record is the only one of the species being found on *Nicotiana Tabacum*.

Peronospora minima sp. nov.¹⁷

Hypophyllous, forming an irregularly distributed grayish growth over the entire under surface of the leaf, epiphyllous discoloration apparently merely chlorotic; conidiophores straight or slightly flexuous, 2-10 from a stoma, short and little branched, 150-300 \times 8-10 μ , branching 1-3 or 4 times, the branches straight, ultimate branchlets at acute angles, axial scarcely deflected, sometimes ultimate branchlets arise in groups of three, conic, 15-20 \times 4-6 μ , occasionally the conidiophore is reduced and bears only 3 or 4 conidia-bearing branchlets; conidia globose, very light yellowish-brown, 28-32 μ ; oöspores subglobose, 65-80 μ , episporule yellowish, wrinkled rather conspicuously; oögonium rather thick walled, slightly larger than the oöspore, somewhat flattened.

Type, in herbarium Wilson, collected by G. Lagerheim at Tromsö, Norway, on *Saxifraga cernua* L., Aug. 1895.

This is the smallest species of the genus and stands out sharply not only from the other species on Saxifragaceae all of which are considerably larger and better developed, but from the species which it appears to approach closest as well. In size and method of branching of the conidiophores it approaches nearest to *P. violacea* Berk., while the globose conidia might suggest a relationship to some of the larger species such as *P. Phyteumatis* Fuckel.

¹⁷ Hypophyllis, conidiophoris densis caespitosis, griseis; conidiophoris rectis vel flexuosis, 2-10-fasciculatis, brevis, pauci ramosis, 150-300 \times 8-10 μ , 1-3 vel 4-ies ramosis, ramis rectis, ultimis conicis, 15-20 \times 4-6 μ , vel conidiophoris minimis, cum 3-4 conidiis; conidiis globosis, diluto-aureo-bruneis, 28-32 μ ; oosporis auriis, diam., 65-80 μ .

EXPLANATION OF PLATES CXXXV AND CXXXVI

Plate 135. *Peronospora Lepidii* and *P. Chamaesycis*

Figs. 1-10. *Peronospora Lepidii*. (Figs. 1-7 on *Lepidium virginicum* from Kentucky—N. Am. Fungi 1406b.—Figs. 8-19 on *L. ruderale*, from Victoria, Australia.)

Figs. 1-5. Conidiophores of the American specimens.

Fig. 6. Two conidia from the same specimen.

Fig. 7. Group of oöspores from the same specimen.

Figs. 8, 9. Conidiophores of the Australian specimen.

Fig. 10. Two conidia from the same specimen.

Figs. 11-13. *Peronospora Chamaesycis*. (On *Chamaesyce serpens* from Kansas—Fungi Columb. 1750.)

Fig. 11. Conidiophore.

Fig. 12. Group of conidia.

Fig. 13. Two oöspores.

Plate 136. *Peronospora* on *Saxifragaceae*

Figs. 14, 15. *Peronospora Chrysosplenii*. (On *Chrysosplenium alternifolia* from Bohemia.—Sydow Phyc. Prot. 202.)

Fig. 14. Conidiophores.

Fig. 15. Conidia.

Figs. 16, 17. *Peronospora Saxifragae*. (On *Saxifraga granulata* from Bohemia.—Sydow Phyc. Prot. 220.)

Fig. 16. Conidiophore.

Fig. 17. Conidia.

Figs. 18-22. *Peronospora minima*. (On *Saxifraga cernua* from Norway.)

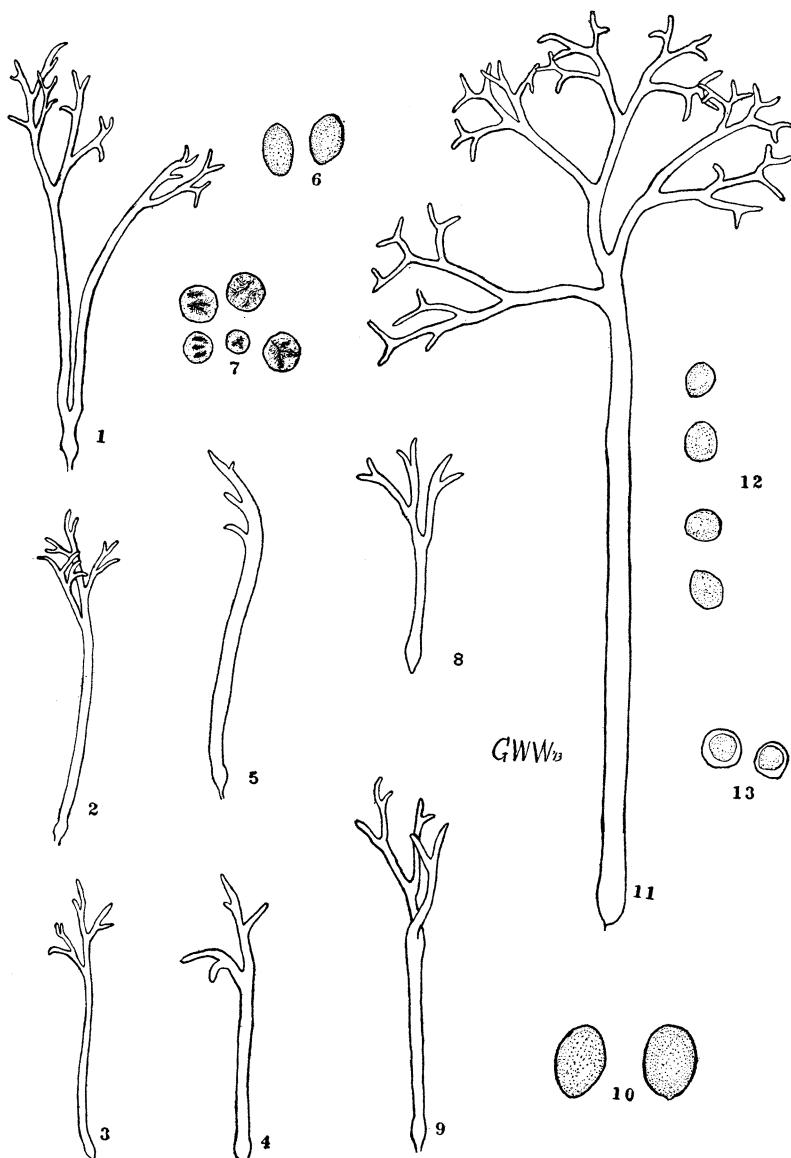
Figs. 18-20. Conidiophores.

Fig. 21. Group of conidia.

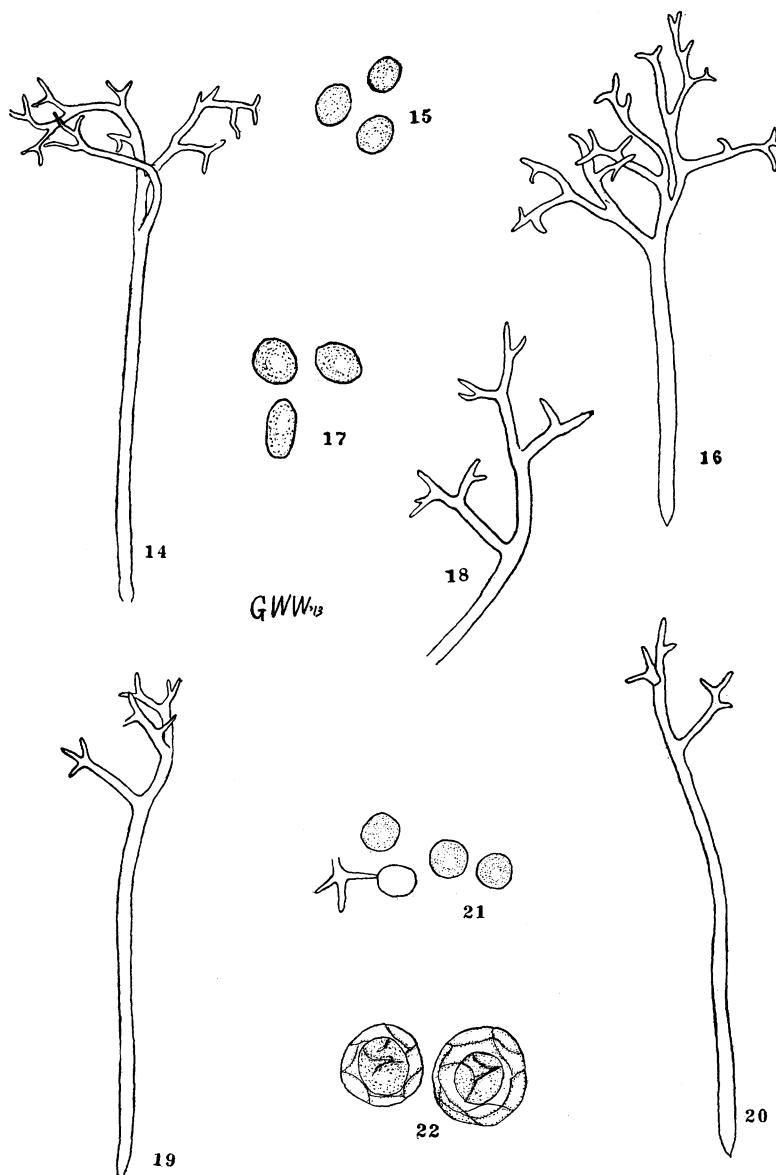
Fig. 22. Two oöspores.

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1-10. *PERONOSPORA LEPIDI*;
11-13. *PERONOSPORA CHYMÆSYCIS*



14, 15. *PERONOSPORA CHRYSOSPLENI*; 16, 17. *PERONOSPORA SAXI-FRAGÆ*; 18-22. *PERONOSPORA MINIMA*